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XXXII.—*On the Willemoesia Group of Crustacea.*  
By C. SPENCE BATE, F.R.S.\*

[Plate XIII.]

AMONG the many objects of interest taken from the depths of the ocean during the cruise of the 'Challenger,' there were few that attracted more attention than the so-called blind Crustacea.

These were described by Mr. Willemoes-Suhm rather fully both in 'Nature' and in the 'Transactions of the Linnean Society,'—in the pages of the former under the name of *Deidamia*; but in the latter Mr. Grote, having discovered that this name had been in use for a genus of Sphingidæ, changed it to *Willemoesia*, in compliment to the unfortunate marine zoologist of the expedition.

Soon after it had been published it was recognized by those who had given attention to the subject to resemble a small crustacean that Dr. Heller had described among the "Crustaceen des südlichen Europa," from a single male specimen in the collection of the museum at Vienna, to which he gave the name of *Polycheles typhlops*, belonging to the same group. I believe that I am correct in stating that Mr. Wood-Mason was the first, in the 'Journal of the Asiatic Society' for 1875, to point out the resemblance between of *Polycheles* of Heller and *Willemoesia* of the 'Challenger' expedition.

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Each of these zoologists has described the animal as being blind; and it is supposed that on this character Heller founded the specific name of his species, the eyes of which, he says, are rudimentary; and Willemoes-Suhm says that "*the eyes are entirely wanting*, nor is there any place left open where you might expect to find them."

Both these observant naturalists have passed over the peculiar character of the organ of vision that belongs to this group of animals. Heller has classified it with the family Astacidæ in a division by itself; and they have both asserted that it closely corresponds with the fossil genus *Eryon*.

Dr. Camil Heller, moreover, says that it bears a strong resemblance in the form of the body to the Scyllaridæ, from which it differs essentially by the structure of the antennæ, the form of the chelæ, and the narrow sternum. With the Astacidæ it has in common the possession of the leaf-like appendage at the base of the second antennæ and the chelate character of the pereopoda; in all other respects it differs from *Astacus*.

Willemoes-Suhm says, "Among the living Decapoda Macrura there is hardly a group with which *Willemoesia* could be said to be very closely allied. Nearest to it are undoubtedly the Scyllarinæ; but these, like all the genera of the family Palinuridæ, differ from it in the absence of the lamellar appendage of the second antennæ, and in the presence of palpi at the base of the gnathopoda, which, as we have seen, are wanting in this new genus. Nor can it, for this latter reason, be referred to the Astacidæ, with which it has in common the presence of the antennal scale."

"The genus," says Heller, "corresponds greatly with the fossil crustacean described by Deshayes from the slate-quarries of Solenhofen (*Eryon Cuvieri*), since also in this are found a flattened carapace and similarly formed antennæ and pereopoda. The hinder part of the body is much narrower than the anterior; and the leaf-like appendage of the second pair of antennæ is much enlarged. It forms a link between the Scyllaridæ on the one hand, and the Astacidæ on the other."

"It is very astonishing, indeed," says Willemoes-Suhm, "that, among all the crustaceans known to us, *Willemoesia* approaches most closely the fossil Eryontidæ. If we compare, for example, our figure of *W. crucifera* with the figure of *Eryon arctiformis*, and the description of the 'Tribu des Eryons' given by Milne-Edwards (and probably taken especially from Desmarest's 'Crustacés Fossiles'), we find most striking resemblances between the two forms. In *W. crucifera*

as well as in *Eryon* the carapace has nearly half the length of the whole body; and in both forms its lateral borders are wing-like expansions which are divided by two deep incisions into three portions. The anterior border of the carapace is nearly straight in both forms.

"*Eryon* was probably not blind; for the eye-stalks have been found in several specimens. Its antennæ seem to be somewhat more reduced than in *Willemoesia*; but the second pair of them has, according to Desmarest, 'une écaille assez large, ovoïde et fortement échancrée.' This is the chief difference between *Eryon* and the Palinuridæ, and the same in which *Willemoesia* also differs from that group."

So much do the fossil and recent animals resemble each other that the discoverer of the recent species says, "If the last pair of pereopoda and the pleon of *Eryon* were presented to me I should undoubtedly declare them to be parts of the genus *Willemoesia*. There are the same line of spines at the top of the rings, the same wing-like expansions on both sides, and that characteristic 'caudal apparatus.' Also the fine fringe of hairs which distinguishes the caudal fin of *Willemoesia* is to be seen in the fossil crustacean."

"*Eryon*," continues the same author, "differs from the living genus chiefly by the presence of eye-stalks and of palpi at the base of the gnathopoda. According to Quenstedt the latter were observed only with difficulty; and their presence seems not to be beyond all doubt." And the lamented carcinologist of the expedition looked forward to his return, when he would look over the original specimens and satisfy himself, so as to enable him to give a more detailed account of the relations of *Willemoesia* to *Eryon*. That they must be very close he had no doubt, and considered that among the Eryontidæ this new genus must take its place, between the Astacidæ and Palinuridæ.

It will be desirable that we should examine the animals and see how far the conclusions arrived at by two independent observers can be supported by extended inquiry.

Heller describes *Polycheles* as having a thin dermal structure, rudimentary eyes, antennæ like those of *Willemoesia*, and four pairs of pereopoda chelate, and one (the fifth pair) simple.

Willemoes-Suhm describes *Willemoesia* as having the eyes and eye-stalks *entirely wanting*; four or five pairs of pereopoda chelate in distinct species.

In all other respects the descriptions of the two authors agree.

The 'Challenger' collection contains specimens of this

group from thirteen different places; and in every one I was able, upon close examination, to find the eyes very distinct, though singularly situated. Moreover there is a variation in form and position that gives them a value in classification, particularly when taken into consideration with the relative forms of the several pairs of pereiopoda.

The dorsal surface of the several species of this group is flattened and depressed, and the anterior margin is tolerably straight; the central tooth, which is sometimes single and sometimes double, is never directed forwards in the form of a rostrum, but upwards and obliquely forwards. In the anterior margin on each side there is a deep cleft in the dorsal surface, in which the eye with its peduncle is lodged; the anterior extremity being directed forwards, outwards, and downwards, is covered over by the lateral projecting wings of the carapace. It appears to have two points of vision, the one upwards by the dorsal surface, the other downwards and outwards by the lens at the extremity of the peduncle. But these several points are liable to vary in degree. In some the dorsal notch is almost non-existent, in others it is very deep; and it is by this variation, taken in connexion with the power of change in the form of the pereiopoda, that I purpose classifying the several species of this interesting group.

#### POLYCHELES, Heller.

(Crust. des südl. Europa.)

In this genus I accept the author's definition, that it has the anterior four pairs of pereiopoda chelate and the fifth simple. But instead of saying that the eyes are rudimentary, I assert that they are immovably lodged in a notch in the dorsal surface of the carapace, with the anterior extremity projecting beneath the antero-lateral wing of the carapace.

#### PENTACHELES, n. g.

All the pereiopoda are chelate, and the eyes are lodged immovably in a notch in the antero-dorsal surface of the carapace, with the anterior extremity projected beneath the antero-lateral wing-like extremity of the carapace.

#### WILLEMOESIA, Grote.

(Nature, October 1873.)

All the pereiopoda chelate, and the eyes immovably situ-

ated in the anterior or frontal surface of the cephalon, and neither lodged in a notch in the dorsal surface of the carapace nor covered by the antero-lateral wing of the carapace. Eyes small, directed outwards and forwards.

Of the genus *Polycheles* there are three species in the collection of the 'Challenger' expedition; and of these I take as the type of the group the specimen that has been named by Willemoes-Suhm *W. crucifera*. It agrees with Heller's figure in having but a single rostriform tooth, but differs from it in general form; but it stands, according to its general structure, at the opposite extremity of a series of intermediate forms to *Willemoesia leptodactyla*.

*Polycheles crucifer* (Willemoes-Suhm).

*Willemoesia crucifera*, Willemoes-Suhm, Linn. Trans. vol. i. 2nd series, p. 52, pl. xii. fig. 10, pl. xiii. figs. 10, 11.

Carapace ovate, margins fringed with large teeth; frontal margin armed with a single rostriform tooth and two sharp smaller teeth at the inner angle of the orbital notch; dorsal ridge without teeth, but nodulated, as well as the dorsal surface, where the nodules run in lines corresponding with the limits of the internal osseous formation. Pleon with a spinous carina traversing the median line, each somite being armed with two strong teeth. The eye is lodged in a narrow cleft of the carapace, and projected beneath the antero-lateral wing in the form of a long obtuse point.

This species was taken in the West Indies, off Sombrero Island, at a depth of 450 fathoms, on a bottom of *Globigerina*-ooze. Length  $1\frac{1}{2}$  inch.

*Polycheles Helli*, n. sp.

Lateral margins of the carapace subparallel; anterior division armed with seven teeth, median with four, and posterior with many, decreasing in size posteriorly; dorsal central ridge armed with two rostral teeth, two median, and two on the posterior margin, with a few intermediate. The pleon is carinated on the five anterior somites, the anterior median portion of each somite culminating in an anteriorly directed point. Eye lodged in a deep notch, with the inner and outer canthus smooth. Meros of the first pair of pereopoda armed on the outer side with two teeth, and on the inner with one or two smaller ones.

This species was first taken in lat.  $29^{\circ}55'$  S., long.  $178^{\circ}14'$  W., near Kermadec Island, three or four degrees north of

New Zealand, at a depth of 520 fathoms, on hard ground, where the sea-temperature at the bottom was 6° C.

A fine specimen was also taken 2000 miles from the last place, in lat. 2° 33' S., and long. 144° 4' E., north of New Guinea, at a depth of 1070 fathoms, on *Globigerina*-ooze, with a bottom-temperature of 2°·1 C.

*Polycheles baccatus*, n. sp.

Lateral margins of the carapace subparallel; anterior division armed with twelve teeth, median with five, and posterior with many, extending to the posterior margin; anterior margin serrated and armed with teeth on the inner side of the antero-lateral angle; central ridge projected into a rostriform tooth supported by two small teeth; median dorsal ridge without teeth or spines; but a few bead-like points fringe the posterior part of the median line and the posterior margin. Pleon carinated on each of the four anterior somites and projected into an anteriorly pointed tooth. Eye lodged in a deep notch in the antero-dorsal surface of the carapace. Meros of the first pair of pereopoda smooth, except a small tooth on the outer distal angle.

This species was taken in lat. 19° 10' S., long. 179° 40' E., near the Fiji Islands, at a depth of 310–315 fathoms, on a bottom that is marked "r.c." in the plans.

*Pentacheles* differs from *Polycheles* in having the last pair of pereopoda always more or less perfectly chelate.

*Pentacheles lævis*, n. sp.

Carapace ovate; lateral margins serrated conspicuously at the anterior extremity, the serration gradually decreasing in importance posteriorly; frontal surface having the inner canthus of the orbit produced to a prominent tooth, and two rostral teeth in the median line, behind which, on the median ridge, there are two small teeth; the rest of the dorsal surface is smooth. Pleon slightly carinated, but not very distinctly so. Posterior pair of pereopoda imperfectly chelate.

Taken in lat. 4° 33' N., long. 127° 6' E., at a depth of 500 fathoms, on a bottom of *Globigerina*-ooze with a temperature of 5°·3 C., south of the Philippine Islands.

*Pentacheles Suhmi*, n. sp.

Carapace with lateral margins subparallel; anterior division

armed with five strong teeth, median with two, and posterior with eight or nine strong teeth that are continuous to the posterior margin; frontal margin having a single sharp tooth on the inner side of the orbital angle, and two central rostral teeth, posterior to which are two single and two double teeth on the central dorsal ridge of the anterior portion of the carapace; two teeth closely set are situated on the anterior and posterior extremities of the central ridge. The pleon is carinated, each somite being formed into two unequal teeth, the anterior being the longer and most anteriorly projecting.

Taken in lat.  $47^{\circ} 48'$  S., long.  $74^{\circ} 48'$  W., on the west coast of Patagonia, 120 fathoms, in mud.

*Pentacheles gracilis*, n. sp.

Carapace long, ovate; lateral margins evenly denticulated from the anterior to the posterior extremities; anterior division armed with nine teeth, the median with three, and the posterior with fifteen; the frontal margin has two rostriform teeth, and one still more prominent at the inner canthus of each orbit. The median longitudinal dorsal ridge armed through the entire length with a single row of sharp teeth, of which the anterior are the more prominent. Pleon carinated, but only the three anterior somites are armed with sharp cusps. Anterior pair of pereopoda having several small spines on the inner margin of the meros; posterior pair unequally chelate.

Taken in lat.  $19^{\circ} 10'$  S., long.  $179^{\circ} 10'$  E., off the Fiji Islands, at a depth of from 210 to 610 fathoms, on a bottom of *Globigerina*-ooze, with a temperature of the sea-bottom of  $3^{\circ} 7$  C.

*Pentacheles obscurus*, n. sp.

Carapace with the lateral margins parallel and unevenly denticulated; frontal margin with two central rostriform teeth; divisions of the carapace not well-defined, anterior with three or four small teeth separated from each other, median with three similar teeth, and the posterior with five or six. Anterior pair of pereopoda with the meros short and smooth; posterior pair unequally chelate. Pleon carinated, tuberculous in the median line.

Taken in lat.  $2^{\circ} 33'$  S., long.  $144^{\circ} 4'$  E., north of New Guinea, at a depth of 1070 fathoms, at a temperature of  $2^{\circ} 1$  C., on a bottom of *Globigerina*-ooze.

The only specimen of this species was in a very imperfect

condition, being apparently an animal that had but recently shed its skin.

*Pentacheles auriculatus*, n. sp.

Carapace with the lateral margins nearly parallel ; anterior division with five teeth, median with three, and posterior with five or six ; frontal margin with two long rostriform teeth near the centre, and one small one above the inner angle of the orbit. Median dorsal ridge strongly denticulated on the anterior portion, and having two double spines on the posterior, and a single tooth on each side of the median line on the posterior margin. Pleon carinated, with the ridge on the third and fourth somite produced to a long anteriorly curved sharp point. Anterior pair of pereopoda with meros smooth on the inner surface and one tooth on the outer near the base, and one near the apex ; posterior pair chelate, with unequal dactyla. Coxal plates ridged with markings like small ears.

Taken in lat.  $19^{\circ} 10'$  S., long.  $178^{\circ} 10'$  E., at a depth of 610 fathoms, off Fiji, on a bottom of *Globigerina*-ooze.

*Pentacheles enthrix* (Willemoes-Suhm, MS.).

Carapace with lateral margins slightly convex ; anterior division with eight teeth, median with four, and posterior with twelve or fourteen. Frontal margin with two rostriform teeth, and a few unequally small teeth between them and the orbital notch ; a few single and double teeth along the median dorsal ridge, two on the central median ridge, and three on each side of the median ridge on the posterior margin. Pleon dorsally carinated and evenly cusped. Anterior pair of pereopoda with two spines on the outer side of the meros ; posterior pereopoda evenly chelate.

Taken in lat.  $29^{\circ} 55'$  S., long.  $178^{\circ} 14'$  W., on hard bottom, at a depth of 520 fathoms, and in lat.  $19^{\circ} 10'$  S., long.  $179^{\circ} 40'$  E., at a depth of 315 fathoms.

*Willemoesia leptodactyla*.

*Willemoesia leptodactyla*, Willemoes-Suhm, Linn. Soc. Trans. vol. i. 2nd ser. p. 50, pl. xiii. figs. 1-9.

Carapace with the lateral margins subparallel or slightly convex ; anterior division with six teeth, median with four, and the posterior with fifteen. Frontal margin with slight orbital notches, and a single rostriform tooth in the centre. Median dorsal ridge armed with a few sharp teeth. Pleon carinated, each of the five outer somites having a sharp anteriorly

directed tooth. Anterior pair of pereopoda having the outer margin of the meros smooth, and the inner fringed with small spines, and a large anteriorly directed tooth on the inner surface of the dactyloid process of the propodos. Pleon carinated, the five anterior somites produced into sharp, anteriorly pointed cusps.

Taken in lat.  $21^{\circ} 38' N.$ , long.  $44^{\circ} 39' W.$ , at a depth of 1900 fathoms, in the middle of the North-Atlantic Ocean, on a bottom of *Globigerina*-ooze, with a bottom-temperature of  $1^{\circ} 9 C.$ , and near the island of Juan Fernandez, at a depth of 1375 fathoms on *Globigerina*-ooze,  $1^{\circ} 8 C.$

POLYCHELES.		fathoms.	Temp.	
crucifer .....	West Indies.	450	..	<i>Glob.</i> -ooze.
Helleri .....	Kermadec Isl.	520	$6^{\circ}$	Hard.
„ .....	New Guinea.	1070	$2^{\circ} 1$	<i>Glob.</i> -ooze.
baccatus .....	Fiji.	310	..	r.c.
typhlops .....	Mediterranean.			
PENTACHELES.				
lævis .....	Philippine Isl.	500	$5^{\circ} 3$	<i>Glob.</i> -ooze.
Suhmi .....	Patagonia.	120	..	Mud.
gracilis .....	Fiji.	610	$3^{\circ} 7$	<i>Glob.</i> -ooze.
obscurus .....	New Guinea.	1070	$2^{\circ} 1$	<i>Glob.</i> -ooze.
auriculatus .....	Fiji.	610	..	<i>Glob.</i> -ooze.
enthrix .....	New Hebrides.	315	..	r.c.
WILLEMoesia.				
leptodactyla .....	North Atlantic.	1900	$1^{\circ} 9$	<i>Glob.</i> -ooze.
„ .....	Juan Fernandez.	1375	$1^{\circ} 8$	<i>Glob.</i> -ooze.

The eyes of the several genera although they may differ from each other in structural detail, yet correspond throughout the group in a common characteristic. The peduncle is reduced to a minimum and fixed as a rigid part of the dermal structure, over which a portion of the carapace is projected.

If we turn to the animal while it is yet embryonic (and our only opportunity is its observation before it has quitted the egg) although in an advanced condition, we see that previously to the eruption from the ovum it attains at least the zoëa stage of development, and that the eyes are large and distinctly pedunculated, just in the same way as the zoëa of *Alpheus* in the embryonic condition has eyes considerably larger and more like the permanent organ in other genera than the adult parent from which it springs.

The alteration from the original type to a depauperized condition is therefore due to a cause acting through the habits of the animal after it has passed through its zoëa stage. This is precisely the way that *Alpheus* has passed; and as the result has been somewhat similar, it is highly probable that the conditions have been parallel.

*Alpheus* in the young stage is a free-swimming animal with powerful organs of vision; but in its adult condition it burrows in the mud of the sea-bottom, where the eye is of little use, except to see things in close proximity, and where it is liable to injury from rough accidents, unless it were protected, as it is, by the strength of the overlying carapace.

The history of *Willemoesia* and its allies I believe to be very parallel with that of *Alpheus*. In its young stage it has well-developed eyes, which it loses when it has arrived at its adult condition. This I believe to be attributable to a similar cause, viz. that it burrows in the soft mud of the deep-sea bottom.

This is borne out by an examination of the contents of the stomach, which I found to be full of the remains of the structures found in the *Globigerina*-ooze.

That the depauperized state of the organs of vision is not due to the loss of light from the great depth at which *Willemoesia* is taken is evident from the fact that *Thalascaris*, n. g. (Crangonidæ), is taken at depths equally great, and is remarkable for the large size of its eyes.

*Willemoesia*, moreover, is not one of our deepest sea inhabitants. *Willemoesia leptodactyla* was taken both in the Atlantic and Pacific at a depth of 1900 and 1375, while *Polycheles Helli* and *Pentacheles obscurus* were taken north of New Guinea at a depth of 1070; yet most of the other species, even including *Polycheles Helli*, were taken at depths between 610 and 120 fathoms.

The bottom temperature has only been recorded in seven of the stations at which the species were taken—that is, only from the deeper soundings; these, however, vary from 6° to 1°·8 C. I am therefore inclined to think that temperature can only be second to that of the character of the sea-bottom itself.

Out of the thirteen stations from which specimens of this group have been recorded, the bottom consists of what has been named *Globigerina*-ooze in eight, one is recorded of mud, and two “r.c.” (which, I suppose, means red clay), and one only on hard ground; but as this occurs only once, and that with an animal (*Polycheles Helli*) that is also recorded from another station where *Globigerina*-ooze exists, I think that we may safely infer that the whole group are inhabitants of a soft bottom, preferring that in which animal life suitable for their existence abounds, and that their general structure and form are in accord with their habitat.

## EXPLANATION OF PLATE XIII.

Fig. 1. *Pentacheles enthrix*.

Fig. 2. The same : eye, seen from beneath.

Fig. 3. The same : chela of the posterior pair of pereiopoda.

Fig. 4. *Willemoesia leptodactyla* : anterior portion of one side of the carapace, showing eye and 1st and 2nd antennæ.

Fig. 5. The same : frontal margin of carapace, showing eyes, seen in front.

Fig. 6. *Polycheles crucifer* : anterior portion of one side of carapace, showing eyes and the 1st and 2nd antennæ, seen from above.

Fig. 7. The same : eye, seen beneath and in front.

Fig. 8. The same : fifth pair of pereiopoda.

XXXIII.—*On a Collection of Lepidoptera recently received from Madagascar.* By ARTHUR G. BUTLER, F.L.S., F.Z.S., &c.

THE Lepidoptera here enumerated were collected by the Rev. William Dean Cowan.

The series of butterflies in the collection represents rather less than one third of those hitherto recorded as occurring in Madagascar ; and, owing to the careful manner in which Mr. Cowan has recorded upon each envelope all facts known to him respecting the species therein contained, not a little information respecting the habits and distribution of the Mascarene forms has been gained.

The collection contains forty-one butterflies and fifteen moths, as follows.

## RHOPALOCERA.

## Nymphalidæ.

## SATYRINÆ, Bates.

## MYCALESIS, Hübner.

1. *Mycalesis ibitina*.

*Mycalesis ibitina*, Ward, Ent. Mo. Mag. x. p. 60 (1873).

One female found in the forest, Fianarantsoa.

This is the first time that I have seen this species. It is a singular form, having the under surface of the secondaries clouded and striated like a *Pedaliodes*.

2. *Mycalesis perdita*, n. sp.

Upper surface chocolate-brown, with a slight purple gloss ; secondaries with an ill-defined blackish submarginal line. Wings below a little paler than above, with the exception of a